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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/004,386	12/03/2001	George D. Papasouliotis	M-12019 US	5934

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EXAMINER
THOMPSON, CRAIG

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 06/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/004,386	PAPASOULIOTIS ET AL.	
	Examiner	Art Unit	
	Craig A Thompson	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 August 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4 and 6-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4 and 6-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This Office Action is a correction to the previous non-final rejection of Paper No. 8, filed 10/7/2002.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-4 and 6-20 rejected under 35 U.S.C. 103(a) as being unpatentable over Papasouliotis (U.S. Patent No. 6,030,881, " '881 ") in view of Perry et al. (U.S. Patent No. 5,705,419, " '419 ". The '881 reference qualifies as prior art for a 35 USC 103 rejection under 35 USC 102(b) because it was published more than a year prior to the current application. "A 35 U.S.C. 103 rejection is based on 35 U.S.C. 102(a), 102(b), 102(e), etc. depending on the type of prior art reference used and its publication or issue date. For instance an obviousness rejection over a U.S. patent which was issued more than 1 year before the filing date of the application is said to be a statutory bar just as if it anticipated the claims under 35 U.S.C. 102(b)." See MPEP 2141.01(I) paragraph 2.

The examiner notes that claim 1 does not require use of a pure hydrogen plasma, accordingly any previous reference that teaches, for instance a

hydrogen halogen mixture for plasma etching would render the claims 1-20 obvious over '881.

Claim 1 of '881 teaches a process in IC production for filling a gap having an opening of initial width in the surface of the substrate including: depositing a film in the gap using an HDP CVD process having an etch dep ration of 0.02 (less than one), stopping the depositing before the opening closes, etching the film in the gap, stopping etching before the corners of the elements forming the gap are exposed and later depositing a film in the gap. '881 fails to expressly teach using a hydrogen-plasma chemical etch. Hydrogen plasma etches are well known in the art of semiconductor manufacturing. '419 teaches that the use of a hydrogen plasma (hydrogen bromide) facilitates etching in a partial and controllable manner (see column 5, lines 21-37). The process is expressly taught to prevent formation of stringers (abstract and title). At the time of invention it would have been obvious to one of ordinary skill in the art of semiconductor manufacturing to have modified the process of '881 according to the teachings of '419 and used hydrogen plasma etching as in claim 1 of the current invention. The motivation would have been suppression of stringers as expressly taught by '419.

With respect to claims 2 and 4, processing with high frequency power and with or without bias are obvious because they are optimizations of plasma processing for AC or DC plasma electrode processing. With respect to claim 3, processing without argon is obvious because '881—claim 5 teaches that other

inert gases, neon or krypton, can also be used. With respect to claims 6 and 7 it is obvious to select oxygen, silane and an inert gas because '881—claim 5 teaches its use. With respect to claim 8 it is obvious to repeat the steps because '881—claim 6 teaches its use. With respect to claim 9 it is obvious to use an undoped silica glass because '881—claim7 teaches its use.

With respect to claim 10 it is obvious to use a doped silica glass because '881—claim 8 teaches its use. With respect to claim 11, a heated and cooled thermal chuck because '881—claim 10 teaches its use. With respect to claim 12 the use of a resistively heated chuck is obvious because '881—claim 11 teaches its use. With respect to claim 13 backside cooling with helium is obvious because '881—claim 12 teaches its use. With respect to claim 14, the reduction or removal of '881 and '663 would follow the general stochiometry of hydride reduction, although the actual ionized or otherwise excited species of the reaction real time, would be discrete. Accordingly the general accordance of the silicon dioxide removal is obvious because it is the generalized stochiometry of silicon dioxide reacting with dihydrogen as is well known as discussed above for claim 1.

With respect to claim 15, '881 teaches that the processes used for deposition and etching cycles can be identical (see claim 7, lines 10-12). Accordingly the use of HDP CVD processes for hydrogen plasma etching is an obvious selection. With respect to claim 16, the depth of the etch is an obvious selection because the etch is for the exact same reason as '881, namely cusp oxide removal to prevent voids. With respect to claim 17, the optimization of

frequency power is obvious and furthermore would constitute optimization of conditions, for, for example self-biasing. With respect to claim 18, non-fully directional etching is obvious because '881—16 teaches its use. With respect to claim 19 etching *in situ* is obvious because '881—claim 22 teaches its use. With respect to claim 20, processing in one chamber is obvious because '881—23 teaches its use.

Claims 21-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Papasouliotis ('881) in view of Perry et al. ('419). The '881 reference qualifies as prior art for a 35 USC 103 rejection under 35 USC 102(b) because it was published more than a year prior to the current application. "A 35 U.S.C. 103 rejection is based on 35 U.S.C. 102(a), 102(b), 102(e), etc. depending on the type of prior art reference used and its publication or issue date. For instance an obviousness rejection over a U.S. patent which was issued more than 1 year before the filing date of the application is said to be a statutory bar just as if it anticipated the claims under 35 U.S.C. 102(b)." See MPEP 2141.01(I) paragraph 2.

'881—claim 24 teaches a process in IC production for depositing an oxide film to fill a gap, the first deposition is using HDP CVD with an etch/dep ratio of 0.02 to 0.025 (less than one), the process is stopped before it is no less than 40% of the initial width (less than closed), the oxide film in the gap is etched insitu with an HDP etching process, the etch is stopped before the corners of the elements are exposed, and an oxide film is later deposited in the gap.

'881 fails to expressly teach using a hydrogen-plasma chemical etch. Hydrogen plasma etches are well known in the art of semiconductor manufacturing. '419 teaches that the use of a hydrogen plasma to controllably etch and prevent formation of stringers (column 5, lines 23-37, abstract, and title). At the time of invention it would have been obvious to one of ordinary skill in the art of semiconductor manufacturing to have modified the process of '881 according to the teachings of '419 and used hydrogen plasma etching as in claim 21 of the current invention. The motivation would have been suppression of stringers as expressly taught by '419.

With respect to claims 22 and 24 high frequency power and use of a bias are obvious selections because they are optimizations of plasma processing for AC or DC plasma electrode processing. With respect to claim 23, processing without argon is obvious because '881—claim 5 teaches that other inert gases, neon or krypton can also be used.

With respect to claims 25 use of non-fully directional etching is obvious because '881—claim 16 teaches its use. With respect to claim 27 the reduction or removal of '881 and '663 would follow the general stochiometry of hydride reduction, although the actual ionized or otherwise excited species of the reaction real time, would be discrete. Accordingly the general accordance of the silicon dioxide removal is obvious because it is the generalized stochiometry of silicon dioxide reacting with dihydrogen as is well known as discussed above for claim 21. With respect to claim 28 the use of the HDP CVD process for etching is obvious because '881 teaches using the same chamber. With respect to claim

29, the depth of the etch is obvious because the etch for '881 is conducted for the exact same reason (prevent void formation). With respect to claim 30 use of low frequency radiation is obvious because '881 teaches its use (tables 3 and 4).

Cited Prior Art

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Chang (U.S. Patent No. 4,361,461) teaches that the use of a pure hydrogen plasma is known to erode pure silicon as well as etching silicon dioxide or silicon nitride (see column 2). The method taught is the etching or semiconductor oxides using H_2 gas in a plasma (see column 2, lines 46-65). Perry et al. (U.S. Patent No. 5,342,801 teaches the use of a hydrogen plasma for controllable etching in device formation (abstract, title and column 5). Zaldivar (U.S. Patent no. 5,385,857) teaches the use a hydrogen fluoride based plasma etch and that it advantageously promotes etching with no flow glass remnants (see column 7, lines 22-50).

Hydrogen Has Quasi-periodic Relation to Halogens

The examiner further notes that unlike Group I metals, hydrogen has no p-shell electrons and has a quasi-periodic relationship with the halogens because it similarly is one electron short of a noble gas (helium) configuration. Consider, for example, the five elemental diatomic gases: iodine, bromine, chlorine, fluorine, and hydrogen. Furthermore, historically hydrogen was commonly placed with the halogens, rather than the group I metals. Because the figures of the current invention appear to depict an etch-effect substantially the same as those of '881 (no apparent difference or advantage) and considering the relationship of hydrogen to, for example the halogen fluorine used in '881 (column 7, lines 60-65), the examiner respectfully submits that the substitution of hydrogen for a fluorine based etch would have been obvious based on the scientific knowledge of one of ordinary skill in the art of semiconductor fabrication.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Craig A. Thompson whose telephone number is (703)305-4789. The examiner can normally be reached on Monday-Friday from 8:00 am to 5:00 pm. The examiner can be reached electronically at craig.thompson@uspto.gov for assistance on procedural matters.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at (703)308-4940. Fax numbers for the group include (703)305-3431 and (703)308-7722. Any inquiry of a general nature relating to the status of this application should be directed to the group receptionist whose telephone number is (703)308-0956.

Craig Thompson
5 June 2003